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# Book Review

*Publishers are invited to send two copies of new books for review to Dr. I. Michael Ross, Code: AA/Ro, Department of Aeronautics and Astronautics, U.S. Naval Postgraduate School, 699 Dyer Road, Monterey, CA 93943.*

## *Computational Flight Dynamics*

Malcolm J. Abzug, AIAA Education Series, AIAA, Reston, VA, 1998, 500 pp., $94.95, ISBN 1-56347-259-7

Professor Abzug has provided an alternative to the standard reference works of Professor Bernard Etkin, which have been the mainstay of stability and control work for students of aeronautical engineering for many years. Professor Abzug's recent work, *Airplane Stability and Control*, is highly acclaimed, and so I looked forward to receiving and reading his latest work, *Computational Flight Dynamics*.

My initial reaction was that the book was not what had been expected on the basis of the title. The book can be broken into two major pieces: 1) the first section, Chapters 1 and 2 (pages 1 through 98), is a solid introduction to modeling of flight mechanics, guidance, and control; 2) the second section, the remaining 6 chapters (pages 99 through 242), serves as a user's manual for programs provided with the book. The provided programs allow a root loci (s-plane and z-plane), a time history transient response to inputs, a flight path calculation program, and a covariance propagation program. Also provided are appendixes (pages 243 through 462) of flight dynamic models of several example aircraft. These include everything from a Schweizer sailplane, an Uninhabited Air Vehicle, and an F-4C jet fighter, to a B-747 in landing configuration. Listings of the programs (FORTRAN) are also provided. The modeling of the flight mechanics will be of the most interest to professors and students, whereas the programs will probably be of interest to small scale designers.

The programs are not in widespread use, although they have been used to design aircraft and appear to have served ably in the author's use. Most large organizations of aircraft research and development, test and evaluation, and/or design and analysis houses will already have equivalent tools or methods to achieve the similar results.

A quick review of the references shows many of the names that one would expect to be cited in a work on this topic. However, the contributions of many authors that might be expected are not found. Vladislav Klein, Mark Tischler, Juri Kalviste, and Kenneth Iliff are just a few authors that have made significant contributions in this field but are not recognized or discussed.

The derivation of the basic equations is covered briefly but very thoroughly. Sign conventions are explained in detail so that there can be no misunderstanding (sign conventions are not standardized anywhere within the aerospace industry and such discussion is de riguer before any further work in flight mechanics). Atmosphere models and basic aircraft motions are included as expected. But also included are discussions of landing gear, gusts, buoyancy, fuel slosh, and axis translation/rotation (should the origin not be defined at the center of gravity). Although brief, the introduction to flight mechanics is thorough and excellent. And while the emphasis is on linear models of the aerodynamic stability and control, the derivation leaves the application of nonlinear modeling easy to apply; this is not always the case with other texts that purport to treat flight mechanics.

System matrix models are used for the control and guidance. At this point the text begins to diverge from that of a fundamental textbook to a user's guide for the provided programs. A two-subsystem model is used, which makes the separation of the airframe and the controller simpler to analyze and change. The big advantage is obviously that changes are easily made and evaluated back to back so that the results of the change can be easily seen. Physical implementation issues are also discussed, an excellent introduction again. Transport delays, actuators dynamics, sensor characteristics, lags, etc. are all here. This development is a great service to the student, as "real world" effects and results are given alongside the theoretical background. Too often texts simply dismiss the applications of such systems or the implementation is left to the reader, an expensive proposition in the aerospace community.

The remainder of the book is the "user's manual" for the programs. However, there is still much general development of the problems associated with flight mechanics. Issues such as trim, discrete sample rates, and noise are discussed. In general, the developments of these concepts are brief as with the aerodynamic stability and control, but the thoroughness of the text is excellent in the treatment of flight mechanics.

In summary, this book is not quite as advertised in the title. But it is a very useful addition to any engineering library when used to complement other texts (Abzug's "Airplane Stability and Control" or Etkin's "Dynamics of Flight: Stability and Control") in flight mechanics and control. It will not replace any of the existing texts, but it will certainly earn its place alongside the classics of this topic, even if the user does not take advantage of the provided analysis programs. For those who are looking to

establish these tools, the book and its software will provide an excellent tool in the understanding, analysis, and design of aircraft flight dynamics. The text does not read easily, but all the pertinent information is at hand. And several concepts are introduced from the "real world," which increases the applicability of the book.

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